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BIOLOGICAL EVALUATION OF THE MARMOT PICNIC AREA, CALAVERAS RANGER DISTRICT, STANISLAUS NATIONAL FOREST

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ABSTRACT

A brief survey revealed that Fomes annosus root disease is prevalent in red fir stumps throughout the Marmot Picnic Area. Many red firs have been attacked by fir engravers and roundheaded fir borers, and some have died from a combination of root disease and repeated insect attacks. Several windfallen firs exhibited extensive root decay. Contributing factors include the decadence of the overstory red fir, harsh winter weather, and shallow soils. Management alternatives include no action, salvage, sanitation and planting, and thinning.

On August 17, 1983 we visited Marmot Picnic Area with Aileen Palmer and Duncan Wurm of the Calaveras Ranger District, and Mike Rutty, Assistant Forest Silviculturist.

OBSERVATIONS

The stand is composed of an overstory of mature-to-overmature red fir and an understory of red fir and lodgepole pine, with a few western white and Jeffrey pine mixed in. The stand age is 130 years, stand density about 200 sq. ft./acre, and site quality III (Forest Survey Site Class); until the recent deaths of many larger red fir, the stand was overstocked. The stand was salvage-logged during the early 1970s, and the picnic area was built two years ago. A history of fir engraver (Scolytus ventralis) attacks, dead tops, mortality, and windthrow following recent heavy winters led District people to suspect that Fomes annosus might be a predisposing factor.

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We found either Fomes annosus conks (fruiting bodies) or a laminated, annosus-type decay in most of the 30 red fir stumps examined. Near the parking lot are several disease centers or stump fields that are surrounded by large red fir (35+" dbh) with thin crowns and occasionally dead tops. We found evidence of fir engraver attacks on dead and dying pole-size red firs, and of roundheaded fir borer (Tetropium abietis) galleries at the bases of declining over-mature firs. Several large firs that toppled during last winter's storms had sparse root systems rotted by F. annosus.

Other factors contributed to the mortality and windthrow in the Marmot Picnic Area. Twenty-two feet of snow covered parts of the site during the worst of last winter, and much snow damage was evident, particularly to sapling and pole-size fir near root disease center openings and in the shallow, sandy soils near the stream. Salvage logging during the early 1970s and site contruction two years ago caused some soil compaction and wounding of residual trees, which reduced tree vigor and may have increased the risk of fir engraver attack.

Several presently minor disease conditions were noted also. High in the crown of one small sawtimber-size red fir we observed yellow witch's broom, a rust disease of true firs caused by Melampsorella caryophyllacearum. Several lodgepole pines were infested with dwarf mistletoe (Arceuthobium americanum); the parasite did not appear to be widespread or particularly damaging, but a more extensive survey would be needed to more fully assess the extent of the infestation. Some lodgepole pines also exhibited long, sunken, perennial stem cankers caused by Atropellis piniphila.

PEST BIOLOGY

ANNOSUS ROOT DISEASE

Fomes annosus attacks a wide range of woody plants, decaying the wood and killing the sapwood and cambium. The fungus can spread long distances above ground by air-borne spores; these are produced by conks in decayed stumps, under the bark of dead trees, or under the duff at the root collar. The spores may land on freshly-cut stump surfaces or on wounds in living trees, where they germinate and infect the new host.

Once established in a stump or tree, the fungus grows into and through the host roots until it contacts the roots of adjacent trees, where it infects and invades their root systems. In this way, annosus disease spreads from stumps or dead trees into the roots of living trees in an enlarging infection center. The fungus may spread underground into adjacent fresh stumps or recently-dead trees, but only if they are not already decayed by other fungi.

F. annosus can remain viable in infected roots or stumps for as long as 50 years. Infection centers usually continue to enlarge until the fungus reaches natural barriers such as openings or groups of non-host plants. Young conifers established within infection centers often die shortly after their roots contact infected roots in the soil.

F. annosus attacks most conifers; Pacific madrone is the only hardwood known to be infected. The fungus kills pines relatively quickly without causing extensive decay. It spreads through the inner bark and sapwood of the root system, killing these tissues; within 2-6 years it reaches the root crown and girdles the tree. By contrast, true firs are seldom killed directly. The fungus spreads into the heartwood of the larger roots, and then into the lower bole of the host, where it causes a butt rot. Vigor and volume are reduced, but death is usually the result of insect attack or windthrow.

Generally, firs growing within pine disease centers are highly susceptible to annosus infection, while pines adjacent to infected fir stumps usually escape attack. Thus, large fir infection centers can be revegetated by selecting for or planting pines.

FIR ENGRAVER

The fir engraver (Scolytus ventralis) attacks both white and red fir in California. Trees ranging in size from large saplings to overmature sawtimber are susceptible to attack. Attacks cause patch-killing of cambium along the bole, top-kill, or the death of an entire tree. Top-kill and death are often associated with firs that have been weakened by root disease, severe dwarf mistletoe infection, overstocking, soil compaction, sunscald, logging injury, or drought. The fir engraver also breeds in slash and windthrown trees.

The fir engraver usually completes its life cycle in one year, sometimes two. Adults fly and bore into trees or green fir slash from June to September; larvae, pupae, and adults overwinter under the bark. Pitch tubes are not formed as they are with pine bark beetles; the usual evidences of attack are boring dust in bark crevices along the trunk and pitch streamers on the mid- and upper bole. Trees colonized early in the summer may begin to fade by early fall, but trees attacked later in the year usually don't fade until the following spring or summer and the beetles may have emerged by the time the tree fades. Direct control is usually not feasible because of the number and variety of breeding sites normally available under forest conditions. Stand improvement and sanitation measures to keep the trees in a healthy, vigorous condition are the most practical means for minimizing losses.

ROUNDHEADED FIR BORER

The roundheaded fir borer (Tetropium abietis) infests true firs throughout California. It will kill weakened trees, often in combination with S. ventralis, but it is not reported as becoming epidemic. The life cyle is one year. The larvae mainly bore between the bark and wood, although they may bore into the wood to pupate, thus causing timber degrade.

LODGEPOLE PINE DWARF MISTLETOE

Arceuthobium americanum infects lodgepole pine, but never western white pine, Jeffrey pine, or the true firs. Other conifers are occasionally attacked, but hardwoods are immune.

Dwarf mistletoes are flowering plants that require a living host, from which they obtain most of their nutrients and all of their minerals and water. They spread by means of sticky seeds that are forcibly discharged from the plants in the fall and adhere to whatever they contact. If a seed lands on a host needle or twig, it remains there over the winter; the following spring it germinates, and the radicle penetrates the host. The parasite develops a root-like endophytic system in the inner bark and outer sapwood, and produces aerial shoots within 2-4 years after initial infection. Another 2-4 years elapse before seed are produced.

The spread of dwarf mistletoe is limited to the distance travelled by the seed, which from overstory to understory is usually 20-60 feet; with the aid of wind, the seed may be carried as far as 100 feet. A rule of thumb is that dwarf mistletoes can spread a horizontal distance equal to the height of the plants in the infected tree. Because of various limits to spread and the long life cycle, the actual spread rate through an even-aged stand is usually 1-2 feet per year. Vertical spread through a tree crown is about 3-4 inches per year.

The impact of the dwarf mistletoes is influenced by host vigor; slow-growing trees will succumb more rapidly than thrifty ones, and dense, stagnated stands are especially susceptible. Lodgepole dwarf mistletoe often causes large, pendant witches' brooms (abnormal proliferations of twigs that appear as clustered masses of foliage); these are usually most pronounced in the lower branches, and eventually lead to the decline of the upper crown.

Control is accomplished by removal of all infected hosts; by removal of severely infected individuals, combined with pruning of diseased branches from slightly infected trees; or by removal of brooms only to prolong the life of a tree without eliminating the parasite.

ATROPELLIS CANKER OF LODGEPOLE PINE

Atropellis piniphila is a fungus that causes a perennial canker of lodgepole pines. Infection is often limited to trees growing on cool, moist sites, such as those in wet meadows and around lake shores. Enlongated, sunken, resin-soaked cankers on the trunks and branches of infected trees are the most obvious symptom. Black, disc-shaped fruiting bodies 2-5 mm across are often present on the sunken bark surface. The wood at the canker site is stained bluish-black. Although bole cankers can cause severe trunk deformation, they seldom girdle and kill their hosts. Hence, in recreation areas the disease is more a curiosity than a problem.

MANAGEMENT ALTERNATIVES

NO ACTION

Red fir mortality will continue until most of the large trees have been removed from the stand. As they decline, some large firs will become hazardous to picnickers because of dead tops and branches, and inadequate support from rotted roots. Picnic sites occupied by firs will be denuded and lose their esthetic appeal as shade and screening disappear. The continuing presence of weakened hosts susceptible to fir engraver and roundheaded borers will increase the likelihood of attacks on nearby firs. Root-decayed firs will topple and cause damage to stationary facilities, particularly during the winter. The lodgepole pines, which are not susceptible to annosus from fir infection centers, will occupy more of the site in dense, stagnated thickets; these dense young stands will be especially susceptible to infection and damage from nearby overstory dwarf mistletoe infections.

REMOVE RED FIRS AS THEY DIE

Timely removal of dead and dying firs will reduce the risk of engravers attacking nearby firs, but will not deal with the underlying problems of the stand; it is merely a holding action that will somewhat delay the breakup of the old stand. Fomes annosus centers will continue to enlarge at the present rate. Stump treatment with borax will retard the initiation of new centers, but will have no effect on underground spread in existing centers.

REMOVE OVERMATURE RED FIRS AND REPLANT WITH ALTERNATE SPECIES

By cutting the least-vigorous firs, preferably in patches that conform to existing annosus centers, and replanting these sites with lodgepole, western white, or Jeffrey pines, the District will both accelerate and control the inevitable conversion of the most degraded portions of the picnic area. If lodgepole pines are planted in these centers, the District must remove a buffer of surrounding dwarf mistletoe-infected lodgepole to prevent introduction of this parasite into the new stand. Red firs will seed into these centers eventually and, if maintained in a vigorous condition, they will tend to overcome the effects of annosus by growing new roots to replace those lost to the fungus.

THIN THE STANDS TO PROMOTE VIGOR AND REDUCE MISTLETOE

Thinning densely-stocked patches of fir and pine will promote rapid growth and reduce the threat of annosus- and dwarf mistletoe-induced stand stagnation. All stumps resulting from such thinning should be treated with borax according to label instructions (see FSM 2305 and 2331.33, R-5 Suppl. No. 90); use of this pesticide will minimize the number of new root disease centers that become established.

Ignoring all management constraints--budget, personnel, time, and other priorities--a combination of the last two alternatives with the total management plan for Marmot Picnic Area will result in the least damage by insect and disease pests over the long term.